



THE WHOLE ART  
O F

REFLEX DIALLING,

Shewing the way to draw all manner of Dialls  
which shall shew the hour by a Spot of light reflected  
from a Glasse upon any Cieling, or other Object  
whatsoever, without any respect had to the  
Axis of the World, either  
projected or reflected.

A S A L S O

Whether the Glasse lie parallel to the Horizon,  
or oblique unto it.

TOGETHER WITH ALL NECESSARY  
FURNITURE BELONGING  
THEREUNTO.

All performed by an easie Instrument fitted  
with lines to that purpose.

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By JOHN TWYSDEN, M. D. C. L.

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L O N D O N,

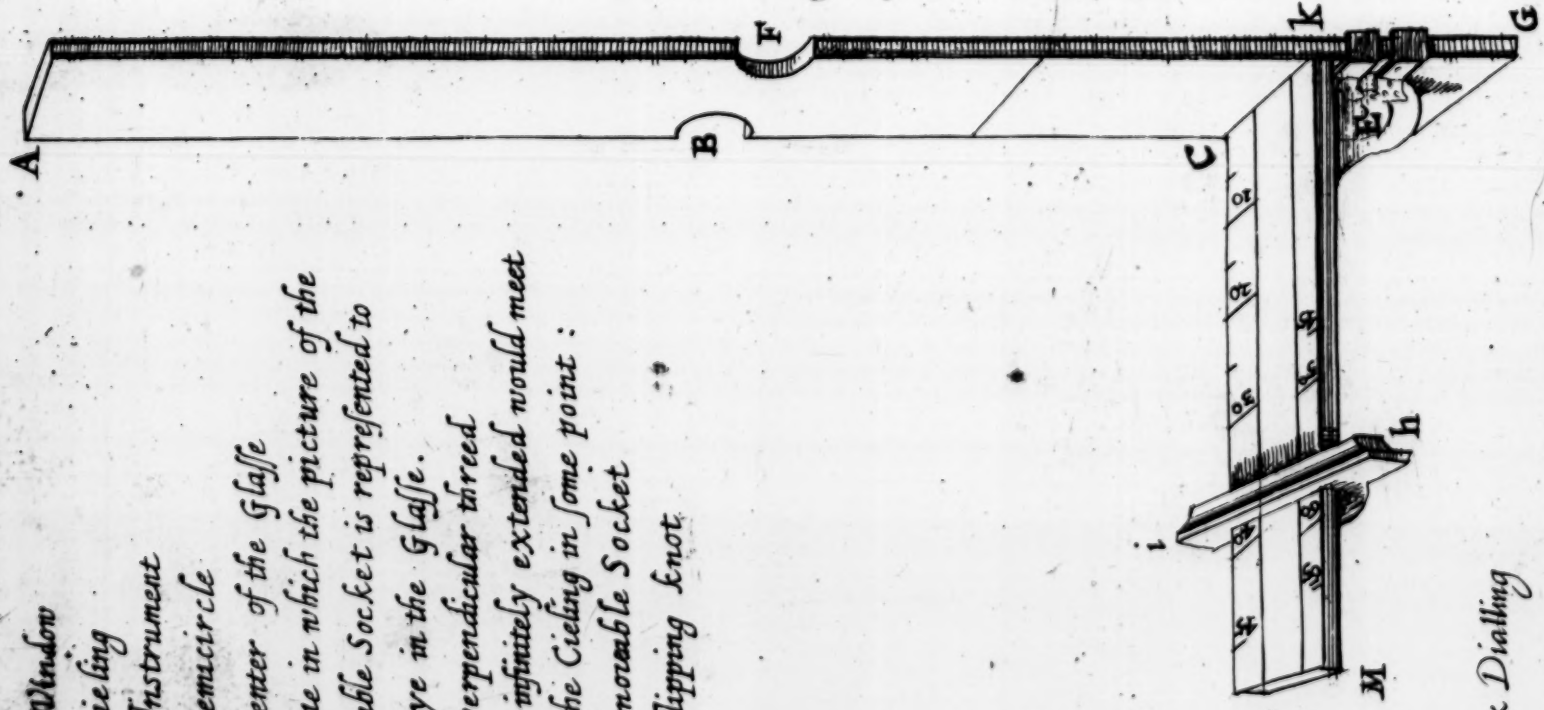
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M. DC. LIX.

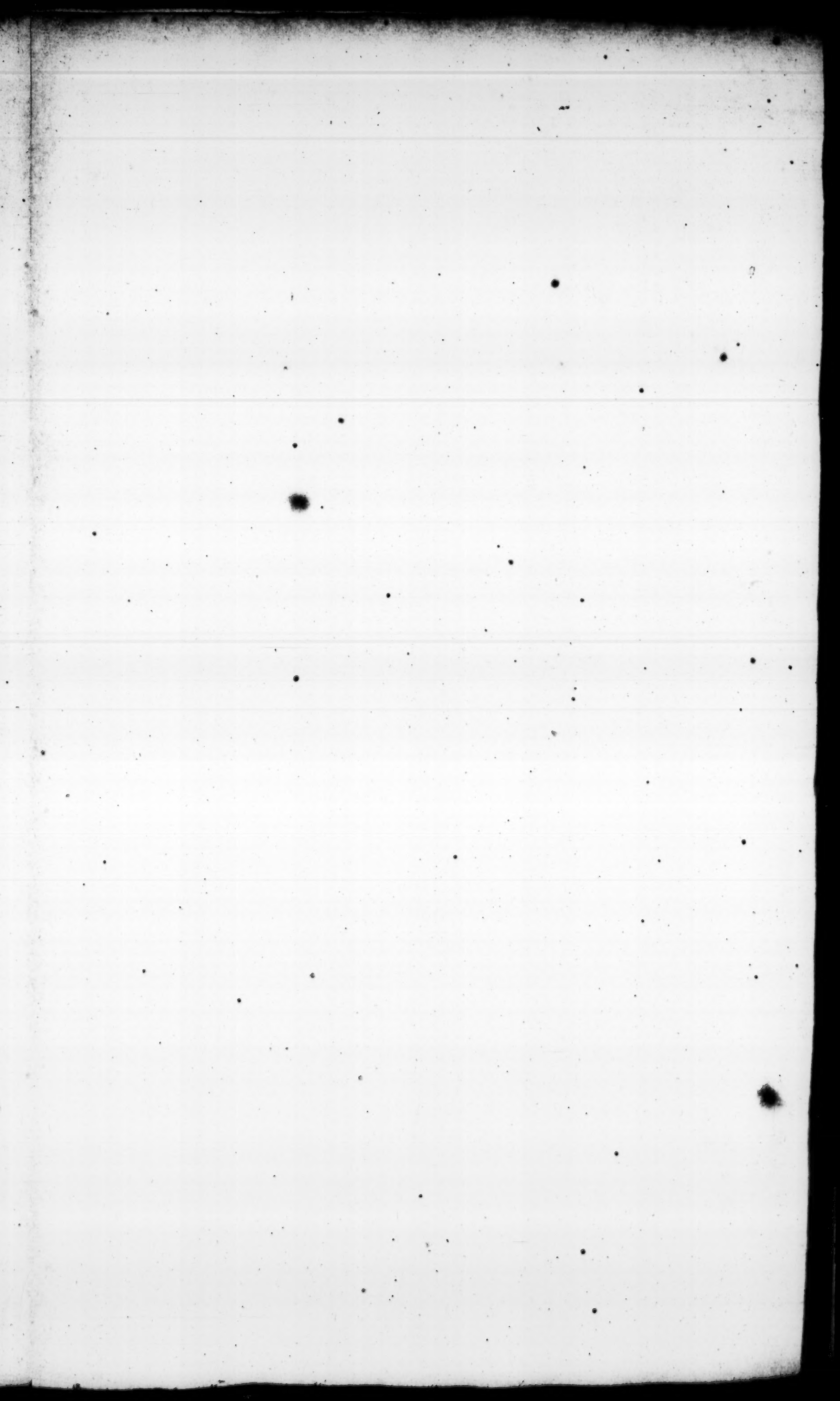
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M.N. the Window  
 O. the Ceiling  
 C.D. the Instrument  
 A.B. the Semicircle  
 H. the Center of the Glasse  
 H.I. the line in which the picture of the  
 moveable Socket is represented to  
 the eye in the Glasse.  
 K.L. the perpendicular thread  
 H.I. being infinitely extended would meet  
 with the Ceiling in some point :  
 F.G. the moveable Socket  
 I. the Slipping Knot



The figure of the Instrument





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C H A P. I.

*The Description of the Instrument.*



Et there be a streight Ruler of Wood, or Brasse made A G, the length, breadth, and thicknesse, at discretion: about the middle of it, or neerer to the end A, let the hollow B be made large enough to encompassse a socket of Brasse, into which the Glasse must be fitted, and so that the fiducial edge A B C, may be imagined to passe through the Center of the Glasse, when it is fixed. On the other side, as at F, may be made another hollow, like that at B, to the end you may use either edge of the Ruler, as occasion may serve, to the end of this Ruler must be added another at right angles C M, made moveable, yet so supported by a bracket E, behind, that it may stand steady at right angles, and unto this let there be fitted a slipping socket with a fiducial edge *h i*; let the piece C M be divided as a tangent line to the Radius B C, and of that length that it may contain about 47, or 48 degrees, which you need not divide beyond 45. On the other side K M, to a shorter Radius, let the tangent line be continued to 64 degrees, or thereabout; which will be farre enough for most Dials of this kind, the whole representing two sides of a Rectangular Paralellogram, or Carpenters square, the one legge longer than the other, all which by the figure annexed, is easily understood.

C H A P. II.

*Precepts for the ready Use of this Instrument.*

**F**irst, in the place where you intend the Glasse shall lye, make fast some piece of Wood or Brasse, exactly Horizontal, unto which you may joyn some other large piece of Board, Pastboard, or other, it matters not, so as it be made to stand firm, and Horizontal, till the Dial shall be finished, and then taken away.

Secondly, Having upon any part of your fixed piece of Wood made a mark, over which precisely shall be the Center of your Glasse, upon this mark as a Center describe so much of a Circle as is necessary, to as large a Radius as the Pastboard will give way, and then the Sun shining hold up a threed, so that the shadow of it may passe through the Center of your Circle, and mark where it cuts the Circumference, and at the same instant take his altitude, and find his Azimuth, either trigonometrically, or by some Astrolabe: (of all projections of the Sphear, I know none so exact for the performance of all things necessary for the making these Dials, and the solution of all other Astronomical Problemes, as that commonly called *Blagraves Jewel*, now put out, every way much amended, and altered by Mr. *John Palmer*, Rector of *Ecton* in *Northampton Shire* my especial friend.)

Thirdly, Having found his azimuth, set off now the South or East line, by help of a Scale of Chords made to the Radius of your formerly described Circle, we will take the Example of an East Dial; As for Example, in the latitude of 52 deg. 15 min. I observed in the Tropick of *Cancer* the Suns altitude 15 deg. 00 min. By my Astrolabe I find his azimuth, then from the East, or six of clock line was 19 deg. or 71 deg. from the Meridian or Midnight line Northward, but because in this Example the Meridian could not be expressed, I set off 19 degrees upon my Circle to the right Coast, and there through the Center draw a line which shall represent the East azimuth.

Fourthly, Your East or Meridian line, if it may be, being thus drawn, have recourse to your Astrolabe, or by Trigonometry find these ensuing things. First, for all necessary houres which will come upon the Dial, find the Suns azimuth, and likewise what altitude it hath in that hour, and azimuth, do this for the Tropick, the Horizon (in Dials made to Oblique Glasses) the *Æquinoctial*, or for as many of the Suns Parallels as you please, I have made choice of the distance upon the Horizon, and Tropick of *Cancer*, for in a flat roof two are enough, because the hours will be streight lines, otherwise if the roof be concave, convex, or any way uneven, it will require the finding of more points, write these down, as in the Table ensuing. *In*



# Reflex Dialling.

3

In the Latitude of 52 degrees, 15 minutes.

Distances from the East  
on the Horizon.

In the Tropick of Cancer.  
Hou. Azim. from East. Suns Altit.

| Hours | deg. | min. |                                  |
|-------|------|------|----------------------------------|
| 4     | 36   | 00   | From East<br>Northward.          |
| 5     | 18   | 40   |                                  |
| 6     | 00   | 00   |                                  |
| 7     | 18   | 40   | From the<br>East South-<br>ward. |
| 8     | 36   | 20   |                                  |
| 9     | 51   | 40   |                                  |
| 10    | 65   | 30   |                                  |
| 11    | 78   | 20   |                                  |
| 12    | 90   | 00   |                                  |

| H. | m. | D. | m. | D. | m. |
|----|----|----|----|----|----|
| 4  | 00 | 37 | 30 | 02 | 00 |
| 5  | 00 | 25 | 40 | 10 | 00 |
| 6  | 00 | 15 | 00 | 18 | 30 |
| 7  | 00 | 03 | 30 | 27 | 30 |
| 8  | 00 | 09 | 00 | 37 | 00 |
| 9  | 00 | 22 | 30 | 45 | 30 |
| 10 | 00 | 40 | 00 | 53 | 30 |
| 11 | 00 | 62 | 30 | 59 | 20 |

The Suns Azimuth, Altitude, and Amplitude, for every hour in the Equinoctial and Tropicks, calculated from 50 to 56 gr. of Latitude.

| 50 d. 00' Tro. S. | Equinoctial | Tropick v | Horiz | Lat. 51 d. 00' Tro. S. | Equinoctial | Tropick v | Horiz |
|-------------------|-------------|-----------|-------|------------------------|-------------|-----------|-------|
| Azim              | Alt.        | Azim      | Alt.  | Azim                   | Alt.        | Azim      | Alt.  |
| 37.24             | 00.37       |           |       | 37.00                  | 4           | 37.24     | 1.13  |
| 26.19             | 8.48        |           |       | 19.17                  | 5           | 26.10     | 9.14  |
| 15.36             | 17.47       | 00.00     | 00.00 | 00.00                  | 6           | 15.18     | 18.03 |
| 4.53              | 27.15       | 11.36     | 9.35  | 19.17                  | 7           | 4.20      | 27.20 |
| 6.49              | 36.53       | 22.52     | 18.45 | 37.00                  | 8           | 7.31      | 36.45 |
| 20.12             | 46.15       | 37.28     | 27.02 | 49.16                  | 9           | 21.20     | 45.53 |
| 37.26             | 54.41       | 53.00     | 33.50 | 62.04                  | 10          | 38.37     | 54.04 |
| 60.38             | 61.02       | 70.44     | 38.23 | 75.45                  | 11          | 61.31     | 60.09 |
| 90.00             | 63.30       | 90.00     | 40.00 | 90.00                  | 12          | 90.00     | 62.30 |

| 52 d. 00' Tro. S. | Equinoctial | Tropick v | Horiz | Lat. 53 d. 00' Tro. S. | Equinoctial | Tropick v | Horiz |
|-------------------|-------------|-----------|-------|------------------------|-------------|-----------|-------|
| Azim              | Alt.        | Azim      | Alt.  | Azim                   | Alt.        | Azim      | Alt.  |
| 37.23             | 1.50        |           |       | 36.14                  | 4           | 37.21     | 2.26  |
| 26.01             | 9.41        |           |       | 18.47                  | 5           | 25.52     | 10.07 |
| 14.59             | 18.19       | 00.00     | 00.00 | 00.00                  | 6           | 14.40     | 18.34 |
| 3.43              | 27.25       | 11.55     | 9.10  | 18.47                  | 7           | 3.18      | 27.28 |
| 8.19              | 36.37       | 24.28     | 17.56 | 36.14                  | 8           | 9.03      | 36.28 |
| 22.16             | 45.31       | 38.14     | 25.48 | 49.24                  | 9           | 23.12     | 45.08 |
| 39.41             | 53.26       | 53.46     | 32.13 | 62.15                  | 10          | 40.42     | 52.47 |
| 62.20             | 59.16       | 71.13     | 36.29 | 75.53                  | 11          | 63.05     | 58.23 |
| 90.00             | 61.30       | 90.00     | 38.00 | 90.00                  | 12          | 90.00     | 60.30 |

| 54 d. 00' Tro. S. | Equinoctial | Tropick v | Horiz | Lat. 55 d. 00' Tro. S. | Equinoctial | Tropick v | Horiz |
|-------------------|-------------|-----------|-------|------------------------|-------------|-----------|-------|
| Azim              | Alt.        | Azim      | Alt.  | Azim                   | Alt.        | Azim      | Alt.  |
| 37.19             | 3.03        |           |       | 35.31                  | 4           | 37.16     | 3.39  |
| 25.42             | 10.33       |           |       | 18.19                  | 5           | 25.32     | 10.59 |
| 14.20             | 18.49       | 00.00     | 00.00 | 00.00                  | 6           | 14.00     | 19.04 |
| 2.49              | 27.31       | 12.14     | 8.45  | 18.19                  | 7           | 2.13      | 27.34 |
| 9.47              | 36.14       | 25.02     | 17.05 | 35.31                  | 8           | 10.29     | 36.08 |
| 24.06             | 44.44       | 38.58     | 24.34 | 49.30                  | 9           | 25.00     | 44.19 |
| 41.40             | 52.08       | 54.29     | 30.36 | 62.23                  | 10          | 42.36     | 51.28 |
| 63.48             | 57.29       | 71.40     | 34.36 | 75.59                  | 11          | 64.28     | 56.35 |
| 90.00             | 59.30       | 90.00     | 36.00 | 90.00                  | 12          | 90.00     | 58.30 |

B

Lat.

| Lat. 56 d. 00' Trop. S |                   |                    | Equinoctial |        | Tropick v |        | Horiz |
|------------------------|-------------------|--------------------|-------------|--------|-----------|--------|-------|
| Hours                  | Azimut            | Altitu             | Azim.       | Altit. | Azim.     | Altit. | Ampl. |
| 4                      | 37.13             | 4.15               |             |        |           |        | 34.51 |
| 5                      | 25.21             | 11.25              |             |        |           |        | 18.55 |
| 6                      | 13.40             | 19.18              | 0.0         | 00.00  |           |        | 00.00 |
| 7                      | 1.31 <sup>n</sup> | 27.36              | 12.32       | 8.19   |           |        | 18.55 |
| 8                      | 11.10             | 35.57              | 25.35       | 16.14  |           |        | 34.51 |
| 9                      | 25.53             | 43.53              | 39.40       | 23.17  | 49.33     | 1.50   | 50.20 |
| 10                     | 43.31             | 50.46 <sup>1</sup> | 55.9        | 28.58  | 62.31     | 6.31   | 64.25 |
| 11                     | 65.6              | 55.41              | 72.5        | 32.42  | 76.5      | 9.29   | 77.29 |
| 12                     | 90.00             | 57.30              | 90.0        | 34.00  | 90.0      | 10.30  | 90.00 |

## C H A P. I I I.

**H**AVING gone thus farre, your next work will be to fasten your Glasse in its socket, to what obliquity you please, at adventure, and so to order all things that the Center of your Glasse may be directly over the Center of your formerly described Circle, and the height of the Center of your Glasse equal to the thicknesse of your Instrument, so that the hollow part of the Ruler encompassing the socket, the fiducial edge may passe through the Center of your Glass, which you may mark with a little speck of ink, till your Dial is done.

The hours are to be drawn in this manner: First, get the points where the hour-lines shall cut or touch the Horizon in the cieling, by which points the Horizon it self may at the last be drawn. These points you shall get, as in this example in the latitude of 51 deg. 00 min. when the Sun riseth at four, I find by the Table annexed in the Column belonging to that latitude, that his amplitude or distance from the East Northward is 37 deg. 19 m. Place therefore the Radius of your Instrument to that amplitude or Azimuth marked before in your circle upon the horizontal board, & the socket being set to the Suns altitude, which is 00 deg. 00 min. observe with your eye where the fiducial edge of the socket in the point of interfection with the altitude, will be reflected from the middle of the Glasse, which you shall find alwayes in the same Azimuth if the Glasse be horizontal: but if the Glasse be oblique to the Horizon, the reflection will swerve toward the Pole Zenith of the glasse more or lesse as the obliquity is. Hang a threed or fasten it in any place, so that holding



holding it between your eye and the glasse, it may catch this reflected socket where ever it comes, and where it cuts the threed tie a slipping knot. Now a threed extended from the Center of the Glasse, by this knot, to the cieling, shall touch the point where the hour-line of four is to cut the Horizon. In like manner, you shall find the points for 5, 6, 7, 8, if need be, and if you will also, for 9, 10, 11, and 12, working by the Amplitudes of the several hour-lines, as you did by the amplitude of four. A line drawn through these points shall represent the reflected Horizon, if you shall have a desire to draw it.

Then lastly, go to your Table for the Tropick of *Cancer*, and in the Azimuths marked in your Circle, and belonging to every hour you intend to draw, place the Radius of your Instrument, as before you did for the intersections of the hours with the Horizon, and move the socket in the upright Ruler of your Instrument to the degree of altitude belonging to that hour you intend to draw, which you shall find in your Table calculated for the elevation of the Pole from 50 deg. to 56 deg. and with your eye reflect it by help of a threed hung up any where, and held between your eye and the Glasse in the same manner as you did the reflected Horizon, and where a threed extended from the Center of the glasse by the knot touches the cieling, that is the point for that hour, and a line drawn from thence to its correspondent in the Horizon, shall represent the line where the reflected spot of light will be for all the yeer.

As for example: In the latitude of 51 deg. 00 min. I find by my Table that the Suns amplitude or azimuth from the East Northward in the Tropick of  $\varpi$  is 37 deg. 19 min. at the hour of four. There I place the Radius of my Instrument, and move the socket to 1 deg. 13 min. the Suns altitude in that hour, then the Instrument remaining in this situation, I reflect the socket as before was shewed. This you must repeat for such hours as you intend to draw, and finish your Dial if you think fit.

☞ Note, When you cannot readily find the image of the socket in the glasse being narrow, you shall lay a broader piece upon the narrower, and having found it in the broader (which will soon be done) keep your eye upon it till some body

| Lat. 56 d. 00' Trop. S |                   |                    | Equinoctial |        | Tropick vs |        | Horiz |
|------------------------|-------------------|--------------------|-------------|--------|------------|--------|-------|
| Hours                  | Azimut            | Altitu             | Azim.       | Altit. | Azim.      | Altit. | Ampl. |
| 4                      | 37.13             | 4.15               |             |        |            |        | 34.51 |
| 5                      | 25.21             | 11.25              |             |        |            |        | 18.55 |
| 6                      | 13.40             | 19.18              | 0.0         | 00.00  |            |        | 00.00 |
| 7                      | 1.31 <sup>n</sup> | 27.36              | 12.32       | 8.19   |            |        | 18.55 |
| 8                      | 11.10             | 35.57              | 25.35       | 16.14  |            |        | 34.51 |
| 9                      | 25.53             | 43.53              | 39.40       | 23.17  | 49.33      | 1.50   | 50.20 |
| 10                     | 43.31             | 50.46 <sup>1</sup> | 55.9        | 28.58  | 62.31      | 6.31   | 64.25 |
| 11                     | 65.6              | 55.41              | 72.5        | 32.42  | 76.5       | 9.29   | 77.29 |
| 12                     | 90.00             | 57.30              | 90.0        | 34.00  | 90.0       | 10.30  | 90.00 |

## C H A P. I I I.

**H**AVING gone thus farre, your next work will be to fasten your Glasse in its socket, to what obliquity you please, at adventure, and so to order all things that the Center of your Glasse may be directly over the Center of your formerly described Circle, and the heighth of the Center of your Glasse equal to the thicknesse of your Instrument, so that the hollow part of the Ruler encompassing the socket, the fiducial edge may passe through the Center of your Glasse, which you may mark with a little speck of ink, till your Dial is done.

The hours are to be drawn in this manner: First, get the points where the hour-lines shall cut or touch the Horizon in the cieling, by which points the Horizon it self may at the last be drawn. These points you shall get, as in this example in the latitude of 51 deg. 00 min. when the Sun riseth at four, I find by the Table annexed in the Column belonging to that latitude, that his amplitude or distance from the East Northward is 37 deg. 19 m. Place therefore the Radius of your Instrument to that amplitude or Azimuth marked before in your circle upon the horizontal board, & the socket being set to the Suns altitude, which is 00 deg. 00 min. observe with your eye where the fiducial edge of the socket in the point of intersection with the altitude, will be reflected from the middle of the Glasse, which you shall find alwayes in the same Azimuth if the Glasse be horizontal: but if the Glasse be oblique to the Horizon, the reflection will swerve toward the Pole Zenith of the glasse more or lesse as the obliquity is. Hang a threed or fasten it in any place, so that holding



holding it between your eye and the glasse, it may catch this reflected socket where ever it comes, and where it cuts the threed tie a slipping knot. Now a threed extended from the Center of the Glasse, by this knot, to the cieling, shall touch the point where the hour-line of four is to cut the Horizon. In like manner, you shall find the points for 5, 6, 7, 8, if need be, and if you will also, for 9, 10, 11, and 12, working by the Amplitudes of the several hour-lines, as you did by the amplitude of four. A line drawn through these points shall represent the reflected Horizon, if you shall have a desire to draw it.

Then lastly, go to your Table for the Tropick of *Cancer*, and in the Azimuths marked in your Circle, and belonging to every hour you intend to draw, place the Radius of your Instrument, as before you did for the interfections of the hours with the Horizon, and move the socket in the upright Ruler of your Instrument to the degree of altitude belonging to that hour you intend to draw, which you shall find in your Table calculated for the elevation of the Pole from 50 deg. to 56 deg. and with your eye reflect it by help of a threed hung up any where, and held between your eye and the Glasse in the same manner as you did the reflected Horizon, and where a threed extended from the Center of the glasse by the knot touches the cieling, that is the point for that hour, and a line drawn from thence to its correspondent in the Horizon, shall represent the line where the reflected spot of light will be for all the yeer.

As for example: In the latitude of 51 deg. 00 min. I find by my Table that the Suns amplitude or azimuth from the East Northward in the Tropick of  $\varpi$  is 37 deg. 19 min. at the hour of four. There I place the Radius of my Instrument, and move the socket to 1 deg. 13 min. the Suns altitude in that hour, then the Instrument remaining in this situation, I reflect the socket as before was shewed. This you must repeat for such hours as you intend to draw, and finish your Dial if you think fit.

¶ Note, When you cannot readily find the image of the socket in the glasse being narrow, you shall lay a broader piece upon the narrower, and having found it in the broader (which will soon be done) keep your eye upon it till some body

body removes the broader Glasse, and you shall easily find it in the narrower, for there about it will passe.

Note also, That if you find not your latitude in the Tables, you must work a proportional part, in this manner: Suppose I desire to draw a Dial in the Latitude of 51 d. 32 m. and would find where the hour of four intersects the Horizon I find not that latitude, but find 50 d. 00 m. and 51 d. 00 m. In 50 d. 00 m. I find the amplitude at 4 h. 00 m. is 37 d. 24 m. In 51 d. 00 m. it is 37 d. 19 m. their difference is 5 m. As therefore 1 d. 5 m. :: 32 m. will be to 2' 40"; which being subducted out of the amplitude belonging to the latitude of 50 d. 37, 24, shall give you 37 d. 21' 20", the amplitude required. Or, adding it to the amplitude of 51 d. 00 m. you shall find the same thing.

#### C H A P. I V.

**T**He parallels of Declination, of Altitude, the Azimuths, Proportions of the shadowes to their gnomons, and the like, commonly called, *The Furniture of Dials*, may be easily inserted by this Instrument, if any man shall desire it. Though to speak my own judgement, I think these kind of additions rather for ornament then use. First, because they are many of them in their own nature difficult to describe, being sections of a Cone, and must therefore be drawn from many points which hath some difficulty in the performance, except where they fall out to be Circles, which case will only happen where the plain passing by the vertex of the Cone makes right angles with the Axis, there the common section is a Circle. If the plain touch the Cone, it will be a Parabola. If it cut it, an Hyperbole. Lastly, If it neither makes right angles with the Axis, and neither cuts, nor touches the Cone, it will be an Ellipsis, or streight lines, as the Azimuths in a flat roof.

Secondly, because when they are drawn, every Astrolabe will resolve the problems more truly then they will.

I might adde a third reason, because the multitude of lines often hinders those that are not used to them, to tell the houre of the Day, which is the chiefe use of Sun Dials, espe-



especially in those of this kind where the shadow of one point of the Axis gives the hour.

Yet, lest any should think this Instrument imperfect, I shall shew the Description of some of them, and leave the rest to the Industry of every Man.

## CHAP. V.

### *The Parallels of Declination.*

**T**Hese are of as great use as any, because the two Tropicks being the parallels of the greatest Northern, or Southern Declination may serve to limit or bound the Dial, and for them I need adde no new Precept, having before in the third Chapter taught you the description of the Tropick of  $\varphi$ . The Tropick of  $\psi$  is described in the same manner by help of your Table, placing your Instrument to the Azimuth belonging to every hour, and marked in your horizontal Circle, and reflecting the socket being before placed to the due altitude. If you desire the intermediate parallels, either you must take the pains to Calculate Tables, or by any Astrolabe, you may perform it exactly enough for this purpose.

## CHAP. VI.

**T**He parallels of altitude are inserted after this manner, not much differing from the former. Suppose, I would insert the 20<sup>th</sup>. parallel of altitude. Move the slipping socket to 20 degrees in the Ruler, and the Radius being placed in any part of the horizontal board, reflect with your eye, by the help of a threed, and a slipping knot, the image of the socket, and carry it to the cieling, do thus till you have found as many points as you please, through which a line drawn, shall represent that Almicanter.

## C H A P. V I I.

*The Proportion of the shadows to their Gnomons.*

**T**Hese are no other then Circles of altitude to a determined proportion, & may thus be set on. Consider first, what proportion you desire to expresse. As for example, I desire to know when the shadow is double to the Radius. I take in my Compasses the length of the lesser Radius of my Instrument, and upon the upright Ruler from 00 d. 00 m. measure that length twice, you will find the Compasses to fall upon 63 deg. 30. m. to that degree and minute, set your moveable socket, then your Instrument being placed as before is taught. *viz.* That the fiducial edge of it, passe through the Center of the glasse, remove it upon the horizontal boord, from place to place, and reflect several points through which draw a line, At all times when the spot is in that line the shadow of all upright thing whatsoever, shall be double to their length; by which means you may find what heighth any Steeple or the like is, by measuring the shadow of it. In the same manner may all other Proportions be inserted.

## C H A P. V I I I.

*To put in the Azimuths.*

**L**ook what Azimuth you desire to expresse: as for example, I desire to put in the 10th. Azimuth from the Meridian. First, upon your horizontal Circle, mark that Azimuth, and next examine what altitude the Sun hath in that Azimuth, in any parallel you think fit, or which is most proper to be made use of, and to that altitude set the socket, and place your Radius in the said Azimuth, then reflect the image of the socket, and carry it to the cieling, it will meet with the parallel if you have wrought truly, there make a mark. Do this for the Horizon, where the Sun hath no altitude, and mark the reflected point, through those two, draw a streight line, if the Roof be flat, otherwise you must seek more points. After the like manner may the unequal hours, the



the degree of the Sun that culminates, and such like, be inserted, which I leave to the industry of every Practiser to perform. I shall now shew a ready way by this Instrument, to make Dials to a flat Glasse, these precepts hitherto being fitted to glasses that lye aslope or oblique, whether convex, flat, or concave.

C H A P. IX.

*How to draw the hour-lines to a Glasse that lies parallel to the Horizon.*

**D**O as you are directed in the foregoing precepts, only instead of reflecting with your eye, you may now place the Radius of your Instrument, so that the upright Ruler may be within the Room, then applying it over in the Azimuth given for that hour, move the socket to the altitude of the Sun in that hour, and from the Center gently extend a threed, which shall shew you one point, do this for as many parallels as you desire, if the Roof happen not to be flat, otherwise two are enough.

For example, in the latitude of 51 deg. 30 m. I draw a Meridian if I can, which is likewise an Azimuth, and find that in the Tropick of *Cancer*, the Sun will then be 62 deg. 00 m. high, to which I move the socket, and gently extend a threed by it to the Roof which shall give the point required. Do this for the *Æquinoctial*, and through the points found draw the hour-lines.

**F I N I S.**